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The Lighting of Churches

By L. C. RETTIG *(Fellow)*

Summary

This paper discusses the illuminating engineering principles applicable to the lighting of churches. The requirements of various denominations are discussed in conjunction with different styles and periods of architecture. Illumination methods and associated fittings are classified and their suitability and limitations for a number of situations are indicated. Notes are included on historical aspects, light sources, installation, and new projects.

Introduction

Of all the many problems encountered in illuminating engineering, those concerned with church lighting are the least easily solved. In no other sphere will be found such a wide variety of architecture, nor such divergence of opinion among the people concerned. In whom is to be vested the authority of the final choice? The church authorities, on economic grounds? The architect, to safeguard appearance? Or the congregation, who will form the largest body of users and critics?

It is suggested that the order of progression should be as follows: The architect, having been instructed to prepare plans for a new church or to improve the lighting installation of an old one, calls for a scheme for lighting from a specialist in that field. He then draws up a specification, including the wiring, etc., and, having selected the best tender from a reputable contractor, submits the recommendation to the church authority, who may, in turn, seek guidance from a national committee, especially if the building is of importance historically. It follows, therefore, that from the inception of a scheme to the placing of the contract the person or persons at succeeding stages must (a) be able to discriminate between good and bad practice, (b) have a thorough knowledge of illumination methods, (c) be conversant with the latest types of light sources and the fittings required to house them.

A truly critical approach to the work must be made, not only with due cognisance of the errors of the past (and they are legion), but also with an unprejudiced spirit that unhesitatingly rejects that which is not worthy of its high ultimate purpose.

Ernest Short, as general editor of that absorbing book, "Post-war Church Building"(1), has clearly indicated in his preface that a purely materialistic outlook must inevitably fail to produce a completely satisfactory result, because it lacks the sense of sacred trust, ignores the individual's responsibility to the community as a whole, and fails to realise that to take part in the work is in itself a privilege. Assuming, then, that a certain state of mind must accompany design, the designer is urged to attend divine service at the church, to gather all possible information about the common activities of its members, and most certainly to spend some time in contemplation within the building, absorbing its atmosphere in the manner of an artist's approach to his subject. Even with new buildings, the time spent in visualising the finished building and creating a mental picture of its interior will assist appreciation of the architect's intended atmosphere.

Since the lay members form by far the largest consensus of opinion, they

Mr. L. C. Rettig is a lighting consultant. The MS. of this paper was received on July 6, 1948. The paper was presented at a meeting of the Society on February 8, 1949.

should also be aware of the considerations involved in the lighting of their particular church. After all, the provision of lighting is mainly for their benefit and to facilitate their full participation in the service. They, particularly, should realise that illuminating engineering is a progressive science and that consideration should be first given to the latest ideas in applied lighting and not to the school whose "olde worlde charme" for traditional surroundings and other prejudices would perpetuate lighting by candles and oil lamps. They should also realise that they are choosing not only for themselves but also for their children, who will have grown up from childhood with the things they themselves regard as innovations. Therefore, their insistence should be upon adequate lighting of good quality, irrespective of fittings design. The aesthetic considerations should be left to the designer and architect.

In this country, besides the main classifications of Anglican, Roman Catholic, and Nonconformist, many sects may be found with differing ideology and ritual, in addition to the establishments set up by foreign nationals for the observance of their particular creeds. With this in mind it will be obvious that inflexible rules cannot be made for lighting churches, especially when we realise that within any one group or sect, buildings will vary in size from mission huts to cathedrals, and in style from Saxon to twentieth-century architecture.

Illuminating engineers will find in this paper much that is elementary knowledge. The omission of calculations may be commented upon. The author's intention is to present the problems involved and some solutions in a manner easily assimilated by all those concerned with church work; and consequently information readily obtained from text-books and other published matter is purposely omitted.

Historical Notes

The earliest gatherings for public worship were in the open air. It is probable that in the Christian era the first indoor services were in the main hall in the residences of the more wealthy members of the community; subsequently chapels or separate apartments were dedicated for religious purposes only, followed by the building of separate churches when the monasteries sprang up in all parts of the country.

Of the Saxon churches which succeeded the monastic order few examples remain, and these have, almost without exception, been rebuilt; unfortunately the early Saxon churches were wholly or partly constructed of timber, and the stone churches which followed were so badly built that they collapsed after a short time.

The Norman conquest was followed by an influx of craftsmen with greater knowledge and skill, with the result that much of their work remains to this day. The rounded arches, circular columns, and massive construction are readily identifiable features of this period, and the progressive refinement of decoration is seen throughout the eleventh century. Were it not for the evidence to the contrary, it would be hard to credit the rapid change which took place about this time to the first of the so-called Gothic styles—the Early English. The adoption of the pointed arch was confirmed, and shafted columns of much lighter construction were introduced.

The twelfth and thirteenth centuries saw the building of many churches of this style, and subsequent styles are to some extent intermingled, as each grew out of the preceding one. Nevertheless, the individual periods known as the Decorated (fourteenth century), Perpendicular (fifteenth century), and Tudor (sixteenth century) are easily recognised by increasing and finer decoration, successively lighter construction, and greater height and breadth.

The flatter arch of Tudor times led to an age wherein the style became debased and was not revived until comparatively recent years.

There is no style of note associated with the eighteenth and nineteenth centuries, with the exception of the Renaissance period, the re-use of classical (Grecian) architectural form by Wren, Inigo Jones, and their contemporaries. Admittedly there is the period of Georgian architecture, but this was practically only used for church work in the chapels and meeting rooms of the Nonconformist groups, where the fitness of the style to the somewhat austere outlook of these bodies is remarkable.

In our own day we have seen the emergence of new thought in all departments of building; the use of brick, concrete, steel, and glass, a departure from tradition which in church circles has profoundly shocked the more conservative members. Nevertheless, the majority of the examples of the new school of thought are fitting successors to those of the older craftsmen, and it cannot be denied that the sweeping use of large surfaces to secure beauty and dignity, in place of decoration and embellishment, is symbolic of the age in which we live.

All these beautiful, historic, and interesting buildings are a heritage, and therefore a responsibility. Those who are entrusted with the upkeep of the fabric of the building proper must also include subsidiary services, not the least important of which is the lighting installation.

It is an inescapable fact that up to about the year 1800 the only available illuminants were rush lights, oil lamps, and candles—light sources of low brightness, very little glare, and usually portable. They did not, and could not, produce the amount of light required to-day; indeed, it was unnecessary, since congregations were entirely illiterate and services were conducted largely from memory by the officiating clergy. Even these gentlemen seldom used lights, because services, normally, were held in daylight hours. The latter years of the nineteenth century saw the adoption of gas where it became available and began an age of crude fittings, installed without experience. Two things are common with gas and all previous systems—the necessity of easy access for lighting and maintenance, and the products of combustion which may damage interior furnishings.

The early years of electric lamps merely produced a cleaner and more convenient light source which could be installed *in place* of previous fixtures. Fixtures were converted for use with the new medium, bare lamps were common and even the shades sometimes employed were typical of the artistically barren years of Victorian times.

Reference has been made(2) to the beauty of some eighteenth century candelabra. It cannot be denied that many fitments for earlier light sources are of artistic merit and craftsmanship almost unknown to-day. In the opinion of the author such fitments are usually unsuitable for conversion to electricity due to (a) despoliation of the original design, (b) the enormously increased intrinsic brightness of electric lamps, which cause glare if mounted at original (access) heights, and if raised to a level which avoids the fault, are both inefficient and too high to be appreciated (see later section on pendants). It is suggested that when architectural opinion demands the retention of these fitments, they be regarded as decoration in their original form, lighting being obtained from a separate installation.

Nomenclature

Church architecture involves the use of terms not commonly known. Architects will appreciate the correct use of these terms when receiving specifications

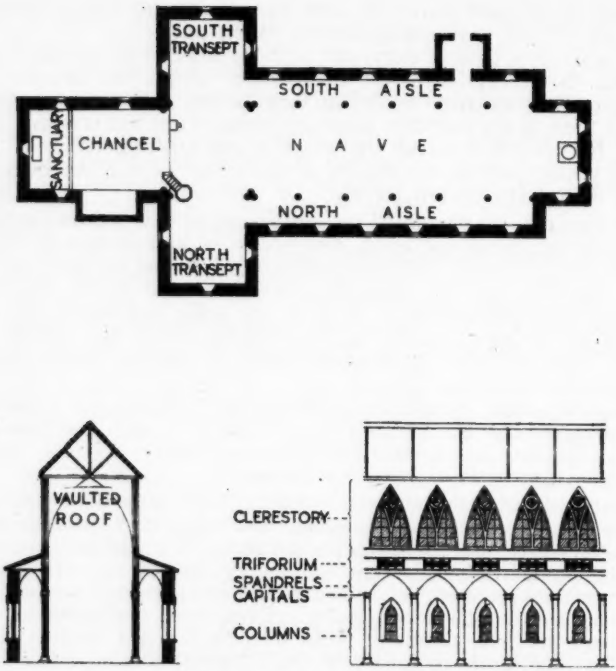


Fig. 1. Showing architectural terms for building features in church interiors.

and it is hoped that the various features shown in Figs. 1 and 2 will be of assistance to installation designers. No attempt has been made to illustrate every feature but only those which may refer to the location of light sources.

The Visual Task

Basically light is required for one reason only—the reading of hymn and prayer books, Bibles and other print. Practically all church services are dominantly oral in character as is evidenced by the very full part taken by blind persons of all denominations. The problem of lighting the area occupied by the congregation is, therefore, essentially simple in its requirements, namely, the provision of the recommended level(4) of 5 lumens per square foot, at 3 ft. from the floor.

In most Nonconformist churches this will apply to the whole of the interior since there is no emphasis required in special areas. In Roman Catholic and Anglican churches it is considered orthodox practice to allow for the increased value of 7 lumens per square foot in the chancel, sanctuary and altar precincts, in order to concentrate attention on these especial places at certain times and generally to emphasise their significance. For the same reason in churches of all denominations there is individual approval of increased illumination on the speaker or preacher during the sermon, as an aid to focus attention. The practice of installing local reading lights on pulpit and lectern is wrong; the illumination of the general area should be sufficient for these two duties, if not, the installation is badly designed.

The recommended illumination values referred to above have been arrived at by studying the type size (usually small) used in hymn books and the like, in relation to the speed of vision demanded. They must be regarded as the absolute minimum. A completed installation should produce light of a sufficiently diffuse quality to ensure freedom from shadow when reading, in a standing posture, a book held just in front of the body. This is a matter of the careful choice and positioning of light sources, considering their area, directional properties and the number employed. Freedom from glare is perhaps even more important and this will be discussed later in the text.

No scheme will be complete without attention to porches, belfries, vestries, organs and approach pathways.

Methods of Illumination

In order to determine the suitability of lighting schemes for ecclesiastical buildings, it is necessary to understand the available methods of illumination. These have been classified under five headings, namely, Direct, Semi-Direct, General, Semi-Indirect and Indirect. It is proposed to deal with their characteristics at some length and to indicate how and where they may be successfully employed.

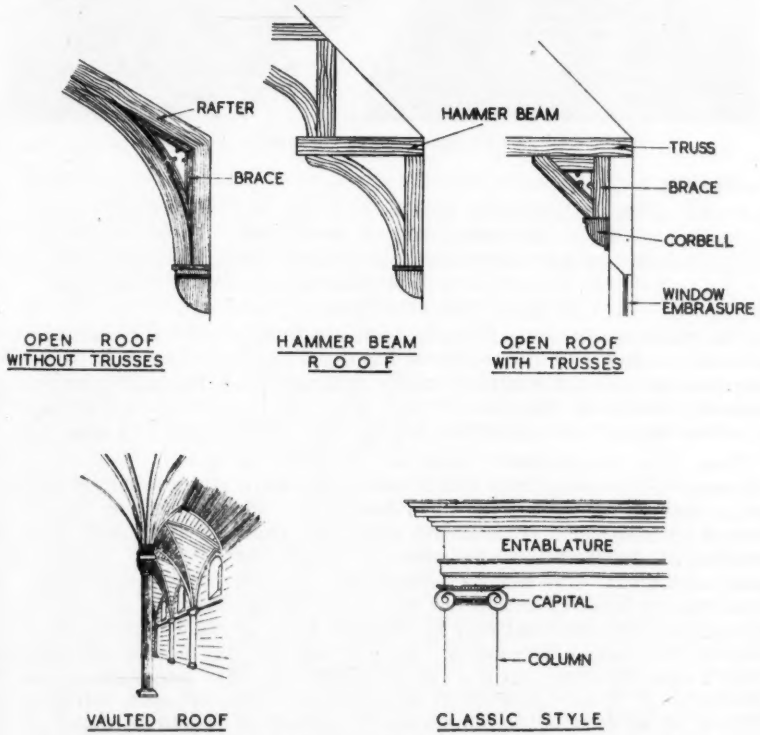


Fig. 2. Further architectural terms used in connection with church interiors.

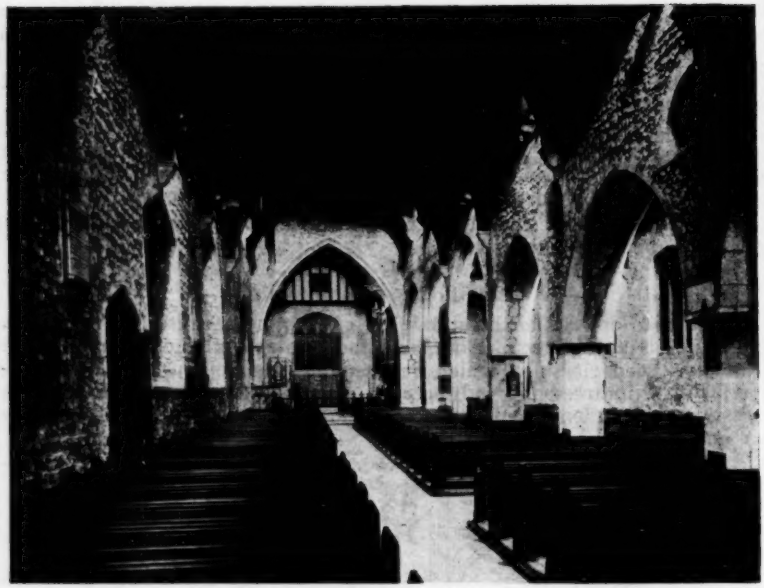


Fig. 3. Example of manner in which equipment can be concealed.

Direct Method

Characteristics: Upward light ... 0 per cent. — 10 per cent.
Downward light ... 90 per cent. — 100 per cent.

Fittings: Opaque reflectors of metal, plated, vitreous enamelled or anodised; glass, silvered or prismatic; flush panels of translucent or prismatic glass built into ceilings.

The major application of this method lies in its use for concealed lighting (sometimes referred to incorrectly as floodlighting), and despite much that has been expressed to the contrary, many architects and lighting engineers are convinced that most effective, efficient and aesthetically correct installations can utilise its principles, provided always that certain rules are observed.

First, true concealment must be available (Fig. 3). The equipment is always of a functional type and is an offence to the eye if mounted in places readily observable. Instances have been seen where reflectors have been mounted on bare walls (Fig. 4) and even upon capitals in classical buildings. Secondly, the building must be used for church services only, postulating a regular and unalterable seating arrangement in order that the reflectors employed may be installed with reference to the normal direction of vision of the congregation. Concealment may be afforded by roof trusses and braces, in the apices of the window recesses of vaulted roofs, in the recesses of clerestory windows and triforium arches, and sometimes in the interstices of heavily timbered roofs. Ideal concealment is afforded by a chancel arch, behind which reflectors can be mounted to illuminate the chancel, choir and sanctuary. Altars can be singled out for special treatment by this means, and, if necessary, further

illuminated by additional reflectors recessed into local window embrasures. This method of chancel lighting should be borne in mind even if necessity demands an alternative treatment for the remainder of the interior.

Fig. 4. Unsatisfactory installation with equipment in full view.

Limitations applicable to other spheres of lighting must be closely followed. In order to avoid glare, no open reflector should be mounted lower than 16 ft. from floor level unless the angle of cut-off is 20 deg. or more below the horizontal. For the same reason specular floodlights of polished metal or silvered glass should not be fixed with the beam centre line much above 45 deg. from the vertical. If these rules are not observed the clergy in particular will suffer discomfort.

When the above conditions cannot be met, the glare can be reduced by the addition to the reflectors of diffusing screens of glass, prismatic lenses, or specially designed louvres to redirect the issuing light in a downward direction; louvres may also be employed when a concealed scheme of transverse lighting at 90 deg. to outside walls can be designed.

The method is sometimes open to criticism on the grounds of "tunnel" effect created by unlighted roof spaces. Often this can be avoided by tilting the fittings within the limits prescribed above, by the use of a fitting allowing up to 10 per cent. upward light, or by the use of small reflectors projecting light upwards, in addition to the main downward units. The latter method is also desirable in some installations where flush ceiling panels, surrounded by dark woodwork, are the sources of light.

Flush ceiling panels or laylights can provide lighting of a character suitable for many Nonconformist chapels and meeting rooms, and may also be used in some modern Anglican churches. Designers of such laylights must be careful in selecting glazing which, whilst possessing a high transmission factor also ensures the obscuration of the lamps and reflectors. The ultimate brightness should not exceed 2-3 candles per square inch, and no part of the glazing should be brighter than five times the lowest value. High brightness ratios are most noticeable in large panels and if correction is impossible, steps should be taken to break down the large area into smaller units by false glazing bars or an ornamental grill. W. Allen, of the Building Research Station, has demonstrated(3) the improvement in the appearance of windows obtained by using a specially shaped bar which is illuminated over the entire inner surface, thus providing a transitional stage between the brightness outside and the dark inner

Fig. 5. Built-in ceiling panel lighting with return panels.

wall surfaces. The principle would greatly improve the appearance of artificial flush panels.

The need to provide supplementary upward light to offset panel brightness can sometimes be avoided by providing a short return panel, bringing the actual glazing a few inches below the ceiling and allowing a small amount of light to reach the surrounding surfaces (Fig. 5). It should be pointed out that prismatic lens panels, round or rectangular, can be incorporated in laylights with great advantage in high buildings, the installed load for a given illumination being considerably lower than if ordinary diffusing glass is used, due to the greater degree of control obtainable.

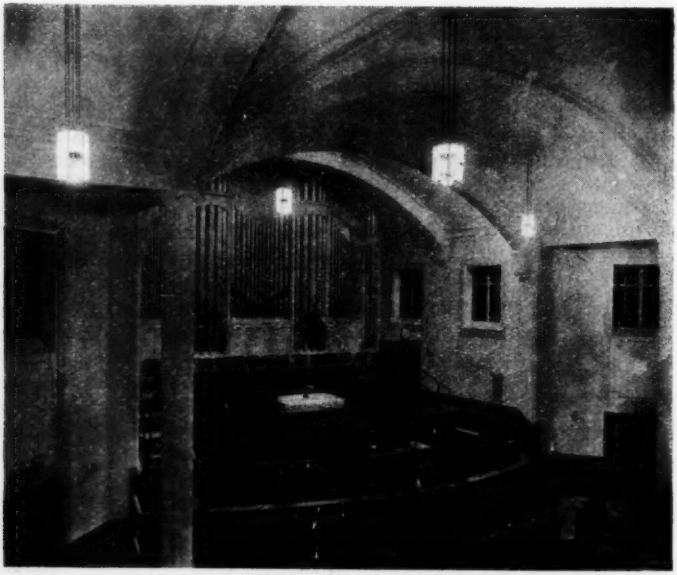


Fig. 6. A well-designed pendant installation.

Semi-Direct Method

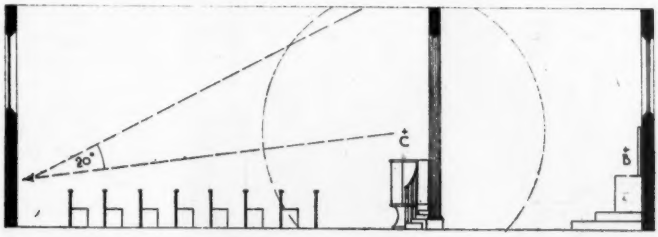
Characteristics: Upward light ... 10 per cent. — 40 per cent.
Downward light... 60 per cent. — 90 per cent.

Fittings: Pendants and brackets incorporating opal, translucent or prismatic glass. Metal fittings of special design. Multi-lamp assemblies of various materials using separate upward and downward units in above proportion.

More sins have been committed against good practice with pendants and brackets than any other system, yet, properly installed, they can be completely harmonious and efficient (Fig 6). Sometimes indeed, they are the only answer to a problem. The principal drawback is that bad positioning can cause an enormous amount of glare; really flagrant examples have been observed with sufficient hindrance to vision to justify immediate condemnation. There are certain limitations which, if observed, will avoid the inherent pitfalls.

First, no fitting should come within a cone radiating 20 deg. from a line drawn from its apex 4 ft. high at the rear of the church to the highest focal point of normal visual concentration. (Usually the face of a person of average height, when standing in the pulpit or rostrum.) It is only reasonable to apply this rule also from the choir stalls and, of course, from the transepts if included in the building (Fig. 7). Secondly, the minimum mounting heights of the I.E.S. Code (4) recommended for various lamp sizes should be adhered to: with a secondary but none-the-less important proviso that the minimum mounting height should not be less than two-thirds the overall height of the interior in order to preserve a balanced appearance (5).

The author dislikes pendants, since anything hanging in an interior seems an afterthought; nevertheless there are many instances where the main area of a hall, used for services, and also for meetings and social events, cannot be adequately illuminated by other preferred methods. Installation difficulties,



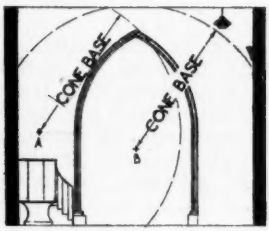


Fig. 7. Sections of a typical parish church showing application of 20° cone limitation for determining minimum mounting heights for pendants and brackets.

Note the three viewpoints and focal points :—
A. From rear of church to pulpit.
B. From rear of church to altar.
C. From rear of transept to pulpit.

such as open roofs or flat ceilings, may also restrict the choice of system, but it is suggested that bracket fixtures are a more pleasing way of providing the well-distributed light required.

For churches used only for services, pendants may also be the final choice where wall spaces which might have housed bracket fixtures are unsymmetrical or already obstructed. Symmetrical layouts are essential with all pendant or bracket systems. It should be borne in mind that very satisfactory results can be achieved by schemes using both brackets and pendants.

Gothic churches respond well to the installation of pendants on the aisle side of the arch apices, the stone work cutting off the light to the nave at an angle which prevents discomfort glare; this method is satisfactory because the aisles are less lofty and usually shorter than the nave (Fig. 8). Some classical architecture can be satisfactorily illuminated by suspending pendants from short brackets fixed above the cornice, when lighting brackets cannot be installed on the walls below this level (Fig. 9). The advantage of moving pendants to positions near the outside walls is obvious, since they are progressing towards or beyond the limits of the 20 deg. cone referred to earlier. Nevertheless, this must not be at the expense of the light required in the centre of the building, which should be not less than 70 per cent. of the maximum.

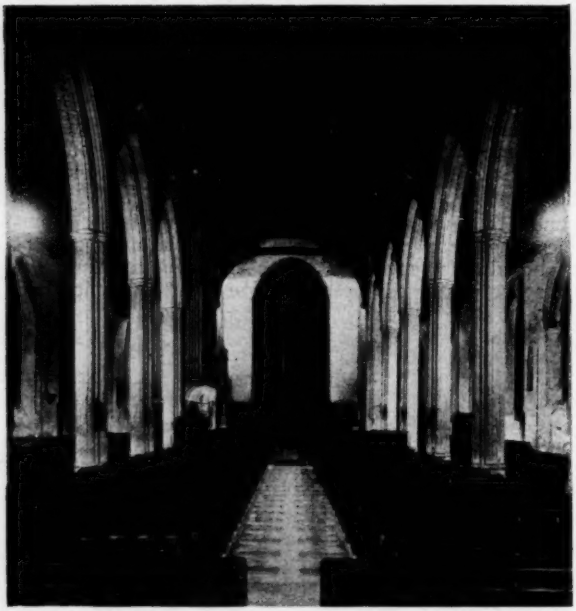


Fig. 8. Showing use of pendants on aisle side of arches.

Pendant fittings are almost inevitable where under-gallery lighting is needed; indeed so obtrusive are some galleries that the whole of the lighting for the ground floor can be provided in this way, fittings of similar design being used at high level to light the gallery proper.

Fittings should always be positioned with reference to architectural features. Pendants may be suspended from, or between, roof trusses and timber junctions or from the centre of plaster panels, rosettes, etc., on a ceiling. Even when presented with a plain ceiling, positions should be chosen between or in line with windows or other symmetrical wall features. Bracket fittings may be located on walls between windows, on buttresses, or in spandrels between arches. Under no circumstances should fittings be fixed to columns

Fig. 9. Installation using pendants on brackets.

or arches; at least we may say that no conscientious architect would condone such practice.

Many fittings of standard manufacture, both pendants and brackets, are suitable for church work. Careful selection will enable completely satisfactory schemes to be devised without the trouble and expense of specially manufactured equipment, especially for the Nonconformist establishments. The provision of adequate fittings for buildings of Norman, Gothic and Classical styles is not always so simple. Often the building has such an individual character that the shape and size of the fittings must be carefully proportioned and the design incorporate suitable embellishments of the period, such as the "Billett" moulding of Norman times, the "Dog Tooth" ornament of Early English, the "Ball flower" of the Decorated style or the Ionic or Doric orders of Classical work. This offers an amazing scope for the designer who can, with restraint, interpret the older embellishments with modern materials and light sources.

General Method

Characteristics: Upward light ... 40 per cent. — 60 per cent.
Downward light... 40 per cent. — 60 per cent.

Fittings: As for semi-direct method, but, in addition, built-in wall panels principally of obscured and/or prismatic glass.

The previous paragraphs describing the semi-direct method, its application and limitations, are all applicable to the general method. The upward component of the light from the former, which is so valuable in reducing brightness contrast in roof spaces, is increased, and should be considered for interiors with heavy and dark coloured timber roofs. The system is obviously less efficient in the lower hemisphere and consumption of energy is consequently greater for a given illumination value on the horizontal plane.

Special fittings which can be classified with those described above, consist of double reflectors throwing light upwards and downwards in about equal proportions but having little or no horizontal component. They are extremely

valuable both as brackets and pendants and, if equipped with louvres at the base, are the logical solution to many problems where the possibility of glare is encountered.

Built-in wall panels are also included in this category but are limited to special architectural designs. It must be remembered that great efficiency cannot be expected since the fitting gives a general distribution and 50 per cent. of the energy is dissipated in the upper hemisphere in addition to that lost in the glass or other obscuring medium. It will be realised that glare may also be serious if panels are mounted too low on the walls; and that the remarks in the previous paragraph on ceiling panels apply equally in respect of brightness ratios, return panels and glazing.

Fig. 10. Church hall with semi-indirect lighting.

Semi-Indirect Method

Characteristics: Upward light ... 60 per cent. — 90 per cent.
Downward light... 10 per cent. — 40 per cent.
Fittings: Brackets and pendants of glass or plastic. Glass-fronted cornices.

Very infrequent opportunities are afforded for installations of this type in churches. The system is a compromise between general and indirect methods, lacking the efficiency of the former, and the dignity of the latter. It may be said that this is a somewhat sweeping statement, but architects will agree that unless the fittings (or cornices) are designed with extreme care, a slightly "hotel or restaurant" atmosphere may unintentionally be created (Fig. 10).

However, the following section describing the indirect method may be taken as applicable also to the semi-direct method in regard to limitations and usage.

Indirect Method

Characteristics: Upward light ... 90 per cent. — 100 per cent.
Downward light... 0 per cent. — 10 per cent.
Fittings: Pendants and brackets of metal or other opaque materials, reflectors concealed in recesses, strip lighting or cornice lighting, special standards.

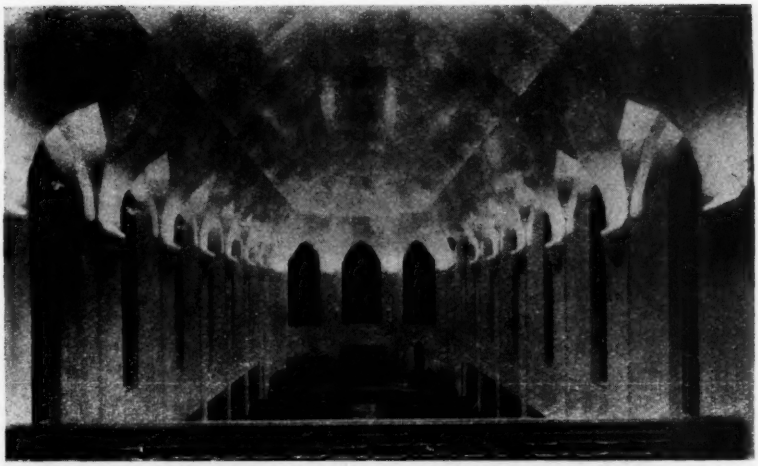


Fig. 11. A modern church with indirect lighting and well-designed ceiling. (Note the glazing bars at the end of the church, designed for artificial illumination.)

Depending as it does on light reflected from ceilings and walls, the indirect method demands not only that these areas are finished in light colours but also a firm guarantee that they will be maintained in this condition by regular cleaning and/or repainting. It is no inexpensive task in these times to refinish large areas of walls and ceilings, and the cost of doing so should be added as a proportion to the annual running charges, which are likely to be 60 per cent. to 100 per cent. above those of a direct installation giving equivalent illumination values. Some people would endeavour to persuade us that the super-quality of indirect systems enables a much lower quantity to be employed, in comparison with all other methods, and yet provide the desired seeing conditions. This theory is completely fallacious and has no support in ophthalmic or engineering circles.

The strictly enonomic aspect of lighting installations ought not to be applied to churches. Considerations of antiquity, appearance, freedom from shadows and available mounting heights will often point to indirect lighting as the only true solution. In these cases the cost must be met.

As already stressed, the surfaces in the upper hemisphere must have a highly reflecting surface, notwithstanding the fact that specular reflectors such as high gloss paint, polished stone and glass are to be avoided at all times, since they reflect an image of the lamps and fittings. The ideal surface is as near white as possible, with a matt or "egg shell" finish. Unbroken surfaces of large area are likewise undesirable and will result in a flat and dull effect. A better effect is obtained where mouldings, beams, ornamental plaster and stonework, curves and vaultings break up the large expanse. One ingenious method of securing this variegated surface is seen in a North London church, where the roof is lined with squares of light-coloured wood arranged with the grain running transversely in alternate rectangles. (Fig. 11.) G. Grenfell-Baines, in his paper "The Lighting of Architecture," [5] has pointed out the need for arranging the cut-off lines projected from the edge of reflectors and fittings to coincide with architectural features such as cornices, junctions of

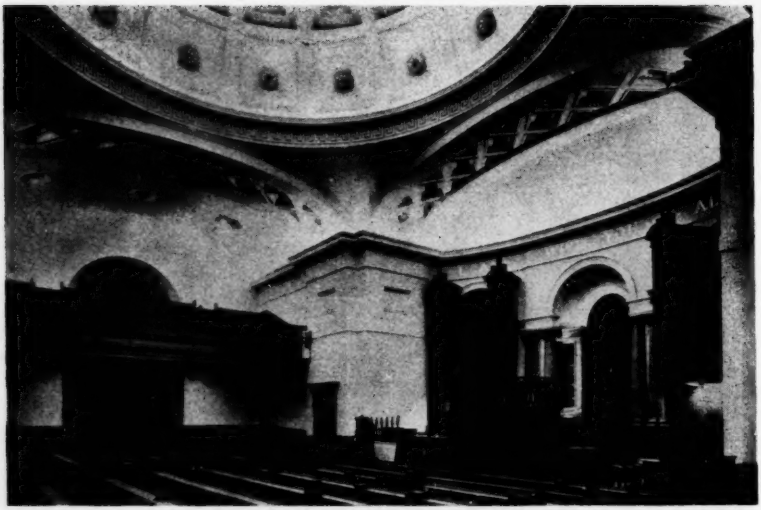


Fig. 12. Example of modern indirect lighting.

walls and ceilings, etc., and the unfortunate appearance when these lines fall across large plain areas. The use of equipment giving a soft gradation from light to darker areas is also strongly recommended. This transitional stage from bright to dark surfaces is extremely important where cornice lighting surmounts dark panelling. The excessive brightness ratio between the woodwork and the brilliantly illuminated frieze or cove above can cause appreciable glare. Reflectors designed to throw the light away from the walls can be used, or the effect minimised by shading the actual wall finish to a darker hue in the vicinity of the light source. (Fig. 12.)

The quantity of light falling upon the reflecting surfaces may be at the ratio of 10/1 maximum to minimum as long as the transition is gradual and the surface is to some extent broken. If large areas of plain surface cannot be avoided the ratio should be reduced. On the other hand, it may be desired to emphasise the form of an arch or dome, and the ratio can then be increased to about 20 or 30/1 between these areas and their surroundings. (Fig. 13.)

Special Problems

In all probability one of the five methods of illumination described in the foregoing sections will meet the requirements in most churches for general illumination of the interior. Nevertheless, there are bound to be occasions when local lighting must be applied in order to increase the light upon altars or other objects of veneration.

One recurring problem is that of revealing the beauty and craftsmanship of gold and silver candlesticks, crosses and other plate. So rich are the ornaments on the reredos on some altars that it is difficult to mark their position at all. One way of separating these objects from their background is to provide lighting at the back of the altar, impinging on the reredos in such a way that the cross and candlesticks are seen in silhouette. Another treatment provides a curtain of dark material behind the altar (Fig. 14), when there is no reredos.

There is no solution when the cross and/or candlesticks are of flat polished metal, since they are in effect a mirror and will only reflect a view of parts of the building structure. Designers of furnishings for churches would be well advised to consider this fact. Designs incorporating an edging of beading with rows of hemispherical projections are ideal both for artificial and daylight illumination, each minute dome being a convex mirror, reflecting light from all the light sources or windows and so defining the outline. (Fig. 15.)

Sometimes a ciborium, often ornate.

Fig. 13. Architectural form emphasised by high brightness ratios.

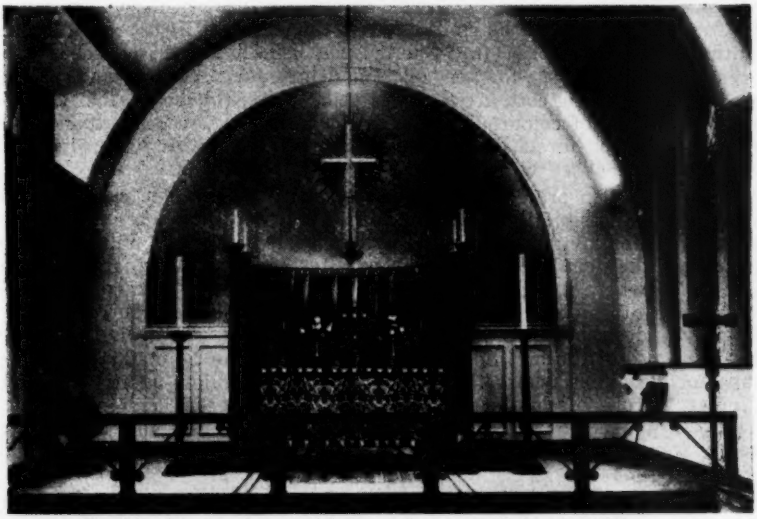


Fig. 14. Showing the use of dark curtains to reveal altar furnishings.

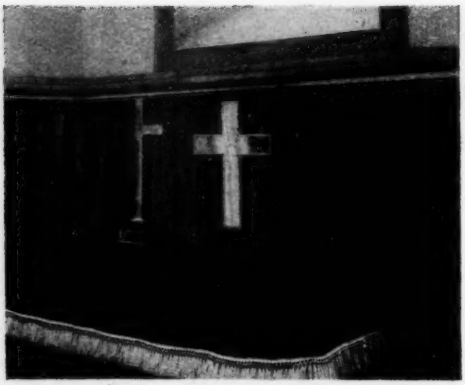


Fig. 15. Plain and beaded crosses compared.

is provided as a sanctuary; this may be all too effective in cutting off the available light on the altar and in casting objectionable shadows from the supporting pillars. It is suggested that local lights should be built in and concealed in the structure of the ciborium itself (in canopy or pillars), and the position of the sources of general light adjusted to throw shadows away from the altar. The use of a tester over the sanctuary is also sometimes responsible for interference with the lighting of the altar precincts. Whether the chancel is illuminated by means of pendants, brackets or concealed lighting, a heavy shadow will be formed on the reredos if the tester is at a low level. When this occurs (a) the tester might be raised to a level avoiding interference; (b) the positions of the light sources may be altered; (c) local lighting, completely concealed, could be designed in the tester itself, the use of louvred fittings being a distinct advantage.

Light Sources

Rejecting high-pressure mercury vapour lamps and sodium vapour lamps because of the colour of the light, we are left with two alternatives: incandescent or tubular fluorescent, including in the latter category the cold cathode high-voltage lamps.

Tungsten lamps can be considered as the standard light source for church lighting for two reasons: (a) because such installations in churches used for services only are in use for very short and infrequent periods, and, accounting the difference in first cost, are the most economical; (b) the warmer appearance in the rendering of colour. This must not be taken as a condemnation of the fluorescent lamp, but it is suggested that the use of this linear light source should be approached with caution.

For conversion projects, where existing wiring of limited capacity is likely to restrict the possible illumination value, fluorescent lamps are invaluable and can be used for laylights, pendants and concealed lighting. In the last-named application they can be used with good effect for the illumination of shallow sanctuaries, where it would be impossible to conceal tungsten equipment. The use of bare tubes of any kind is unthinkable in traditional surroundings, and certainly undesirable in any sphere of lighting work. There is the possibility of making use of the fact that cold cathode lamps can be made in any desired shape for situations where the light source has to follow an irregular cornice or other feature of dominant interest; again, the tube itself should not be visible. Fluorescent lamps are often suitable for church halls used for social events, warmer tints being obtainable by coloration of the glass or plastic surrounds.

Expert advice should be sought before sanction is given to schemes embracing both fluorescent and tungsten lamps, since unattractive colour

variations can arise unless care is exercised in placing, arrangement and concealment: the subject is too wide and controversial to be discussed in this paper.

Installing the Equipment

Many schemes of great merit must be rejected if the installation of the equipment and wiring is likely to be unsightly. Nothing looks worse than conduit tubing running horizontally across architectural features of a dominately vertical character. The concealment of reflectors for direct method lighting has been stressed, but this alone is only half the story if, in the positions selected, the supply to these points is likely to be an eyesore. Designers should, therefore, possess a comprehensive knowledge of wiring methods, particularly in regard to the fabrication and erection of conduit. Steel tubing (conduit systems with screwed joints), due to their permanent character, are likely to be favoured for church installations, as opposed to the semi-permanent character of lead and tough rubber cables. Incidentally, lead-sheathed cables should never be clipped into oak, for acids in the wood affect the sheathing in a very short time. When available, the mineral insulated copper-sheathed cable system will undoubtedly be used whenever the financial circumstances permit its adoption, since it is virtually indestructible, and has great fire-resisting and fire-preventing attributes. Furthermore, it is unobtrusive and can be readily concealed behind mouldings.

The question of wiring methods could be enlarged upon indefinitely, but since this is an attempt to set out the factors affecting the lighting of churches, further reference to the contractor's art must be left to others. Lighting designers must, however, consider the physical limitations of those who will be called upon to erect and install the equipment and wiring, and also the amount of labour subsequently required for cleaning and relamping. Fittings of bracket and wall-fixing types should not be fixed at a greater height than that which can be reached by an extension ladder of normal length. Pendants fixed near walls must be accessible by similar means or alternatively, if in more central positions, reached by step ladders in low-roofed buildings or lowerable in higher situations. In order to lower pendants, winch gear must be provided, and, being unsightly, must be concealed. This is difficult to achieve in an open interior, but is simpler when access above a ceiling is available. Systems using a portable winch for such a situation have been devised.

When ceilings are used for access to pendants or built-in ceiling fixtures, it is usual to provide a boarded cat-walk across the joists and additional lighting in the roof space for the safety and convenience of maintenance personnel.

New Projects

Apart from the conversion of existing buildings and systems, the lighting of new churches must be considered, and also of those being rebuilt after being damaged by enemy action. If lasting beauty and dignity are to be the goal of our endeavour, the architect's conception must include the artificial lighting of the building at the sketch-plan stage, and he should regard the illuminated interior as of equal importance to the daytime internal and external views. The decision on the selected methods of lighting and the fittings ought to precede the final details of structure and finish, in order of design. The lighting installation is of greater importance than the heating of the building, for whereas without heat we feel cold, without light we cannot see at all. Heating apparatus is usually located in the lower wall levels, whereas the lighting equipment is well up in the visual sphere. Built-in or well-placed light sources can be

a major contribution to the artistic whole. Commissioned as an afterthought they may be an everlasting regret.

Conclusion

Having established the need for specialised knowledge and experience in church lighting on the part of the illuminating engineer, and for architects and church authorities to be conversant with current methods of dealing with the problems involved, it is hoped that judgment may be passed on all existing installations, and that new work may be planned in advance, with the co-operation of all concerned, in a manner which will avoid past mistakes, and perhaps also with that spark of inspiration which creates works of beauty and grace.

The illuminating engineer especially should find in Church surroundings an outlet for the expression of the artistic and cultural aspects of his profession, denied him in the major part of his work. He should remember that the results of his endeavour are accessible to everyone and that consequently the achievement of real satisfaction may be something of which he can be justly proud.

References

(1) Ernest Short, foreword to "Post-War Church Building" (Hollis and Carter, Ltd.), 1947.
(2) "The Lighting of Churches" ("Light and Lighting," vol. 41, p. 38, 1948).
(3) W. A. Allen, "Standards and Quality of Lighting in Schools" (Journal of the R.I.B.A., November, 1947).
(4) The I.E.S. (London) Code for the Lighting of Building Interiors (1946).
(5) G. Grenfell-Baines, "The Lighting of Architecture" (Trans. Illum. Eng. Soc. (London), vol. 13, p. 23, 1948).

Discussion

MR. W. T. SOUTER said that church lighting was a complex subject inasmuch as each church had its own specific problems and it was difficult to generalise. These lighting problems were not concerned purely with functional aspects, but were closely associated with the visual appreciation of the beauty and dignity of the church interior; architectural art had found its highest expression in so many ecclesiastical buildings. These special conditions were admirably expressed in the concluding paragraph of the paper, and the sense of appreciation and achievement to which the author referred was not primarily concerned with the knowledge that the lighting engineer had provided uniform illumination of so many lumens per square foot over the seating area of the church and the appropriate illumination value within the chancel or other parts of the building requiring suitable emphasis. If designers analysed their experiences they would find that this sense of satisfaction emanated from the general appearance of the interior as a whole, and the knowledge that they had rendered a service to the congregation in affording them a fuller appreciation of their surroundings and of the service in which they participated.

Taking that thought a stage further, Mr. Souter said it had been his experience that this sense of satisfaction was usually most marked with installations where the lighting fittings were concealed or built into the roof of the church, not merely because the fittings had been removed from the normal line of vision, but also because the general effect was more natural. That was largely because the general direction of the artificial lighting component was

very similar to that of daylight, and architectural features were portrayed in their normal way.

Commenting on the suggestion in the paper that the lighting engineer could profitably spend some time in contemplation within the building and generally absorbing the atmosphere of the church, Mr. Souter said that observation of the windows and the manner in which general daylight was effected, could also be of great advantage to the lighting engineer in enabling him to reproduce the shadows and high-lights, thus revealing the architectural features in the manner originally conceived by the architect.

Stained glass windows were a source of disappointment to the lighting engineer in that no simple and effective means had yet been found which could reproduce their daylight splendour, and that such windows became increasingly lifeless and uninteresting when subjected to excessive interior surface light under artificial lighting conditions.

The author had made several suggestions and recommendations in regard to the application of semi-direct lighting fittings with which Mr. Souter agreed, apart from the suggestion that the minimum mounting height of such lighting pendants should not be less than two-thirds the overall height of the interior. He expressed the view that this might be qualified with the statement that the height and position of the lighting fittings should also be related to the vertical architectural features and structural elements of the building to which they were attached. He illustrated this point with a slide of a typical Anglican church having a lofty nave and side aisles separated by Gothic style arcades, the pendant-lighting fittings being hung on the aisle side of the arch apices. Aesthetic considerations dictated the height of the lighting units, the position being such as to preserve the natural symmetry and balance of the arches. If they were hung too high or too low, the perspective and beauty of the arcade was impaired, and the correct height of the lighting units was influenced by the architectural style and proportions of the arches rather than the height of the aisle or nave. Having fulfilled this aesthetic requirement, the lighting engineer must then employ a lighting unit having suitable light distribution characteristics for the functional requirements.

Mr. Souter agreed that fluorescent lighting should be applied to churches with caution; and while it could be frequently employed satisfactorily for the concealed lighting of the chancel, a great deal still depended on the architectural style of the sanctuary. The diffused nature of the light from such sources could produce a flat and unreal appearance where fine ornamentation and carving were concerned unless the lighting fittings were carefully positioned, and installations existed in which such considerations had been disregarded with unfortunate results.

Finally, speaking of new churches, he strongly endorsed the author's views as to the need for co-operation between the architect and the lighting engineer at the earliest stage. There was no tradition of church illumination which had stood the test of time, and in applying modern light sources and equipment, this co-operation was essential if the functional and aesthetic considerations were to be satisfactorily fulfilled.

MR. R. DAVIDSON emphasised that before the lighting engineer used lead-covered cable or tough rubber-covered cables he should make quite sure that the Diocesan architect did not insist on steel conduits with brass screws. In Chichester Cathedral, for instance, which was in his area, the lighting engineer would have a very rough passage if he used anything but conduit.

One of the troubles was that a church did not behave in the way the

lighting engineer wished it to! And it was quite impossible in nine cases out of ten to use indirect lighting.

Louvres were available which cut out disability glare for the congregation. There were many people who desired to have lighting of such a character that it was not noticed when they entered the church. The result of such a system, however, was that a person in the chancel, and looking the opposite way to the person entering the church, suffered very badly.

Another problem was that in many of the old churches mural paintings were to be found on the walls when the plaster was removed, and the lighting of these was not always easy. That had happened in one church at Berwick, in Sussex, and the question of lighting the church had been gone into all over again. Fluorescent lighting had been adopted, and it made a very fine job.

Church lighting boiled down to making sure of the Diocesan Regulations and to choosing a form of lighting which will harmonise with the character of the church. Electricity would inevitably be used, but there was no reason why pendants or other fittings should not be used, provided they harmonised with the architecture of the church.

MR. HOLMES said that the examples in the paper had related to complete schemes and had not indicated some of the difficulties which nearly always arise in individual cases. Some of these difficulties were illustrated in the installation shown as Fig. 11 in the paper, in which the architect and the lighting engineer appeared to have worked in close collaboration and produced a church in which the day-lighting was excellent and the artificial lighting was good for the particular visual task which Mr. Rettig had described as "the reading of hymn and prayer books." There was, however, another part of the visual task, namely, the need to be able to see the preacher and the need for avoiding distraction or glare during worship. In this particular church, considerations of audibility rendered it necessary to place a sounding board above the pulpit, and the effect of this on the lighting installation was most unfortunate. The preacher was in shadow and the diffusion of the reflected light made it difficult to perceive his expression or the modelling of his features; further, the reflected glare from the two indirect fittings in the apse above the pulpit was a distraction. Attempts were made to remedy the difficulties by local lights attached to the underside of the sounding board and by a fairly powerful reading light above the Bible, but these did not improve the modelling of the features and also resulted in distracting shadows on the wall behind the preacher.

This was an example of an installation which was excellent from one point of view, but was poorly adapted to other requirements of the visual task and was insufficiently flexible to cope with changes in these requirements. The unchangeability of indirect lighting seemed to be a very serious disadvantage in use, and it was nearly always necessary to supplement indirect lighting by directional illumination on particular areas of the church. This brought the installation as a whole into the semi-indirect or general classification, and it was Mr. Holmes's personal opinion that totally indirect lighting was not generally suitable for churches, partly because of the extreme diffusion of the light and partly because of the unsuitable distribution of brightness in the field of view.

MR. MISSELBROOK thought that the author had rightly emphasised the viewpoint of the preacher, which was a thing so often overlooked in church lighting

installations. These were often very effective from the point of view of the congregation, but the preacher and the choir were often condemned to spend the greater part of the church service facing a battery of glaring sources.

In his early days as a lighting engineer he was intimately connected with church lighting and it was common practice to plan pendant lighting schemes with the fittings suspended from the apex of the arch. The author had stated that fittings should never be fixed to arches and he would like some further explanation on that point.

He joined issue with the author on the question of the local lighting of the pulpit, although he agreed that from a technical and idealistic point of view the author was correct. In practice, however, it was usual to extinguish a large proportion of the lighting during the sermon, and under these circumstances the use of local lighting was an absolute necessity. The difficult alternative was to persuade the church authorities that they could afford to spend that little bit extra on their current bill.

One slide of an installation of concealed lighting which the author had shown suggested that the mounting height of the fitting was some 40-50 feet. How were these fittings maintained?

MR. R. FELL said he had recently been responsible for submitting two quotations for lighting a church, one with pendant fittings and the other by concealed lighting, the latter consisting of trough reflectors up in the roof at a height of about 50 ft. The authorities were greatly impressed by the latter scheme, but the verger, who was rather old, declined to go up a ladder to maintain the lighting. In the meantime, the acceptance of one or other of the quotations was held up on account of this difficulty of maintenance of the concealed lighting job. His authority—the Eastern Electricity Board—could do it, but it would mean sending out a lorry with ladders and men every time one or two lamps needed replacement. It rather seemed that the church authority would finally decide on the pendant scheme because of the greater ease and lower cost of maintenance and lamp replacement.

MR. DAVIDSON interposed that he was a business man and for a very small annual sum he maintained installations which he had put in. Even with wide areas to cover it was surprising what could be done in a week. If the installation mentioned by Mr. Fell was to be maintained properly they could not expect the verger to do it. The Electricity Board should make this a maintenance job.

MR. FELL replied that he had offered to provide a maintenance service, but it had to be borne in mind that there were not many churches to look after in this way in the area, and it was necessary to pay an electrician and his mate. This particular job would probably be done at cost price, but, frankly, the Church authorities had said that whilst they were prepared to pay £150 to £200 for the installation, they were not prepared to pay for maintenance, and he did not think the Electricity Board could do that free.

THE PRESIDENT remarked that church installations used their lamps for very few hours during the year and would, therefore, require very much less maintenance than the normal installation.

MR. J. A. BROUGHALL suggested that it was necessary to consider what was the fundamental thing which the architect and lighting engineer were doing. It had been hinted several times that the important thing was to get the illumination in the right part of the church, viz., at the altar at the east end of the church. But that was an extraordinarily difficult thing to do and one hardly ever saw a church that was properly lighted in that way. Might it perhaps be that floors should not be lighted generally? Lighting engineers were trying to get an illumination of five lumens per sq. ft. over the whole area, but it seemed to him that the whole thing should now be looked at from a more fundamental point of view.

MR. J. BARRINGTON BAKER, speaking as an architect who was not an expert on lighting, said he was filled with horror at seeing pendants hanging from the apex of arches in churches. He had recently taken out a number of pendants with very good results, and everybody liked the change, even though he had used reflectors which were not entirely concealed. However, they were not very noticeable when the lamps were not alight, and the results when they were lighted up were very satisfactory.

As regards the author's suggestion that the minimum mounting height should be not less than two-thirds the overall height of the interior, it was not always possible to do this and avoid shadows. Therefore he would prefer to have the lights lower in the aisles so as to keep a perfectly open nave. In Roman Catholic churches the same importance was not attached to the reading of hymn books as it was in Nonconformist chapels, and the problem was totally different in the two cases. Therefore it was not quite fair to compare the English church with the Continental church, in which it was more important to have increased light in the sanctuary and the choir. He had used in a chapel industrial fluorescent lighting fittings concealed behind purlins, and, although other speakers seemed to disagree with this, the lighting was excellent, and the fact that industrial lighting fittings were used was not noticed by those using the church.

THE PRESIDENT agreed with the author that the lighting of a church was a job which should extend the whole of the powers of the lighting engineer. When it was a matter of lighting an ancient church, which had perhaps 700 years of history and tradition and piety behind it, something very special should be put forward.

There was a conception that old churches were designed to be seen by daylight; but he did not believe that they were designed to be seen by daylight any more than they were designed from the point of view of acoustics or heating. Those who were in France last year would remember visiting the Abbaye de Royaumont. He himself fell in with a guide, and was interested that his talk in describing the building was all of thrusts and arches and buttresses. Indeed, one's recollection of any Gothic building was of buttresses on the outside and arches and columns on the inside, and it was obvious that the first preoccupation of the builder was to make the building stand up. In the ruins of the nave of the Abbaye de Royaumont on the north side there were the remains of very large lights, but there was none on the south side, because the cloister was built adjacent to the south wall, and the thrust of the nave had been taken through the cloister to a buttress beyond, a construction which the guide said was unique. Day-lighting had taken second place to structural considerations. Indeed, having provided windows, the ancient builder used them for decoration rather than for illumination, filling

the openings with the glory of tracery and stained glass, which made them things of beauty, but ineffective for lighting. Since there was no artificial lighting when these old buildings were built, this meant that the illuminating engineer had now the opportunity of revealing them as they had never been revealed before.

Apart from the obvious requirements of necessary illumination and freedom from glare, there were three aims of church lighting which he would like to suggest to the author. The first was to reveal the architecture of the church. In Westminster Abbey at midday and with artificial lighting one could scarcely see the roof of the nave. A principal aim of the lighting engineer should be to make the whole of the architecture visible in a memorable way.

The second aim should be to achieve the correct emphasis. There were many churches with most beautiful roofs, and it was a great pity if they could not be seen properly; nevertheless, the roof was not the feature of the greatest significance. It would be wrong to make the roof so bright that it took attention away from other features which were more important. The lighting should be so contrived as to lead the attention of the congregation to the right places, and give them due emphasis.

Thirdly, there was the question of modelling, not only of the architecture but of people; especially the preacher. In many of the photographs which the author had shown, for instance, the form of fluted columns had disappeared, in some cases lost. A great deal of care was necessary to reveal their forms properly:* to solve these problems there would have to be used not one of the conventional systems but a judicious admixture of more than one system, particularly in the addition of directional lighting to more conventional systems. He wondered whether there was scope for unsymmetrically disposed lighting equipment. In almost all churches the fittings were placed symmetrically, with the result that the directional effects were confused and modelling lost. During the day there was great beauty in sunlight slanting in through the South windows, revealing by highlights and shadows the modelling of the details of the architecture. Would the beauty be enchanted if there were six suns shining in at all the windows in different directions?

He wondered whether, for concealed lighting of churches there might not be a particularly useful application of reflector lamps as new types became available?

THE AUTHOR, replying to the discussion, said that the recommendation that pendants should have a mounting height of not less than two-thirds the height of the interior meant, in the case of a church, two-thirds the height of the aisle and not two-thirds of the height of the nave. In this way, the fittings would not be visible from the nave and, therefore, did not give an unbalanced appearance compared with the other parts of the church. If they were mounted at less than two-thirds the height of the aisle they would look unsightly. This

* In an excellent paper given before the Society in 1920 on "The Artificial Lighting of Churches" ("Illuminating Engineer," London, 13, p. 142, May, 1920), Mr. John Darch observes: "When lit from below, the cornices, pilasters, and ornaments have an upside-down effect; but where they are lit from in front there is no effect at all, for the shadows are wanting. Sometimes we find a tangle of repeated shadows and highlights that reduces the whole to an architectural puzzle. It is lamentable when the effect of a beautiful work is thoughtlessly ruined by those who profess no knowledge of the architecture and no sympathy with its poetry and sentiment, but it is inconceivable that an architect should be content to see his own work so burlesqued."

Mr. Darch's paper should be read with Mr. Rettig's; though written nearly thirty years ago, the principles which he enunciates are still valid, and he illustrates some very beautiful and well-balanced installations.

recommendation really applied only to the hall type of church where there were no aisles.

He agreed that there was a difference in the requirements of a Roman Catholic church because the type of service did not involve reading a great deal of printed matter. Nevertheless, there was the task of illuminating the interior satisfactorily so that it was artistically pleasing, and this involved the use of *some* illumination, at all events. It was interesting to hear of the use of industrial-type fluorescent fittings concealed behind purlins, and he himself had mentioned, in presenting the paper, that they could be satisfactorily used if concealed. Where the lamps were generally visible to the congregation, however, they were unsatisfactory and undesirable. In spite of the fact that the brightness was reckoned to be within tolerable limits, there would sometimes be an undesirable high brightness ratio in the visual field.

The problem of getting even illumination in the centre seats in the nave was related to the mounting height of the fittings in the aisle but, if standard fittings were not available, it was comparatively easy to design a type of fitting with a much wider type of distribution which would give even illumination over the whole of the seating area. It was a matter for special design and it was difficult to recommend a standard fitting for the job.

The problem mentioned by Mr. Fell of maintenance when the lamps were at a height of some 60 ft. was largely answered by the recommendation in the paper for consideration of this point when designing the installation and, in all probability, the logical solution to that problem would be to have some form of pendant or wall fixture. One speaker had asked about the maintenance of fittings shown in one of the slides at a height of some 50 ft. That slide was one of our oldest cathedrals where there was a passage through the clerestory buttresses which afforded facilities for mounting the reflectors and carrying the cables, and also for easy maintenance.

As regards fixing pendants and other fittings to arches and columns, there was a reference to this in at least six architectural books on the subject where it was regarded as a heinous crime to do so. He quite agreed because it entirely spoiled the symmetry and beauty of an arcade. As far as the illumination on the pulpit and lectern was concerned, a spot-light focused on the preacher gave a good effect and avoided moving shadows behind the speaker during the sermon, which was a most unsatisfactory feature of the use of desk fixtures.

He said he hardly dare reply to the President's remarks, which brought out so many points. Perhaps the best he could do was to agree with them. As usual on these occasions, he was confronted with having prepared a paper, six months in advance of publication and then was presented with the fact that developments had taken place in the meantime, not only technically but also in his own views on the subject.

A very fair analysis had been given by Mr. Holmes of the faults in St. Andrew's Church, Cheam. Actually, he had shown that slide to illustrate a solution to a certain problem and not to deal with the details of the lighting. He had had in mind particularly the breaking up of the surface of the roof by the use of wooden squares arranged with the grain running transversely in alternate rectangles. However, he was indebted to Mr. Holmes for his comments which he would bear in mind in the future.

In reply to Mr. Davidson, he said he was aware that lead-covered and tough rubber-covered cables were frowned upon by Diocesan architects but very often the lighting engineer was faced with the problem of designing installations as economically as possible—as for instance in small Baptist Chapels and other

denominational buildings—and which would not run to the cost of screwed tube. Therefore, some alternative had to be used. Mr. Davidson's remarks with regard to the illumination of murals referred to an isolated case and it must be dealt with by the illuminating engineer on the spot. It was an individual problem and he would not like to express an opinion on it.

On the general question of levels of illumination, as set out in the I.E.S. Code, and the remarks of Mr. Souter, the author said that with the possible exception of Roman Catholic churches, where reading was not of such importance, he would strongly recommend insistence on the levels set out in the Code. The point was that in the installation of such illumination values we were doing something which we knew nothing about when we were young and if children were brought up to use this type of lighting its commonly adopted values would no longer be controversial. The recommended values were even lower than might be adopted in some cases. Indeed, one illuminating engineer had said he was horrified at finding the values so low. He appreciated also Mr. Souter's remarks with regard to stained glass windows. A great deal of their beauty was lost when they were lighted and viewed from within. It was only when they were viewed from the outside that their real beauty under artificial light was apparent.

In conclusion, he expressed his thanks to the Holophane Company for the loan of slides and equipment, to the Lighting Service Bureau for assistance in arranging the demonstrations, and to Messrs. Burns, Oates and Washbourne for the loan of altar furnishings.

SESSIONAL MEETING IN LONDON

A sessional meeting was held at the Lighting Service Bureau, 2, Savoy-hill, London, W.C.2, at 6 p.m. on Tuesday, February 8, 1949, when the president, Mr. J. M. Waldram, took the chair.

The minutes of the last meeting were taken as read and approved, and the secretary announced particulars of forthcoming meetings.

The president then called upon Mr. L. C. Rettig to present his paper entitled "The Lighting of Churches." The paper discussed the illuminating engineering principles applicable to the lighting of churches. The requirements of various denominations were discussed in conjunction with different styles and periods of architecture. Illumination methods and associated fittings were classified and their suitability and limitations for a number of situations were indicated. Notes were included on historical aspects, light sources, installation, and new projects.

After a vote of thanks proposed by the president, the discussion was opened by Mr. W. T. F. Souter, who was followed by Mr. R. Davidson, Mr. J. G. Holmes, Mr. J. M. Waldram, Mr. C. J. Misselbrook, Mr. R. Fell, Mr. J. A. Broughall, Mr. J. Barrington Baker. The author replied to the discussion and the meeting was closed.

The Illuminating Engineering Society is not, as a body, responsible for the opinions expressed by individual authors or speakers.

With a view to avoiding possible confusion with other publications, reference to these Transactions should be in the form :—" Trans. Illum. Eng. Soc. (London). "

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The following applicants have been duly elected by the Council to membership in the Society, and their names have been added to the list of members:—

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The Council have accepted the following applications for inclusion on the Register of Lighting Engineers:—

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Session 1948—1949

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